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How much does disregard of road rules contribute to bicycle-vehicle collisions?

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Abstract

Recent media articles on cyclist safety have supported the contention that many car drivers regard cyclists as risk-takers who violate traffic signals and show a disregard for road rules. There is little empirical evidence, however, regarding the nature and frequency of risk -taking behaviours by cyclists, and the extent to which this contributes to cyclist crashes. We do know that the social cost of bicycle crashes in Queensland in 2006 is estimated at $35.4 million, with the Brisbane area contributing over half the cost alone.

This paper presents a preliminary investigation of the factors that lead to Police-reported bicycle-vehicle collisions, focussing on the extent to which disregard for road rules contributes to these collisions. Preliminary results indicate that cyclists were the at-fault vehicle in 35% of reported crashes. When considering the age of the cyclist, younger cyclists were more likely than older cyclists to be at-fault, with those aged 5-11 responsible in 82% of crashes while those aged 30-39 were at-fault in 19% of crashes. In 77% of crashes involving right-of-way conflicts, vehicles were considered at-fault. The implications of the results for the development of age-appropriate road safety interventions will be discussed.

Keywords

Cyclist, traffic violations, crash

Introduction

Cyclists account for 17.4% of all road users hospitalised in land transport accidents Australia-wide (Berry & Harrison, 2008). Almost half (49.6%) of the cyclists hospitalised in land transport accidents were involved in traffic incidents resulting in serious injury and 46.8% were involved in non-traffic incidents resulting in serious injury. In Queensland, using police data, it is estimated that casualties from bicycle crashes resulted in a social cost of over $35 million in 2006. South East Queensland contributed $21 million (from Webcrash, Queensland Transport, 2007). Research demonstrates that bicycle crashes and injuries are underreported in police data, with this being more extensive than for any other transport mode (Veisten et al, 2007). Stutts & Hunter (1998) found that only 48% of cyclists admitted to hospital as a result of a crash were also recorded in state motor vehicle crash files, and with crashes that occur on roadways only 50% of cases matched. It is may be necessary to consider the varying reporting requirements in different jurisdictions. It was also found that the cyclist profile (age, location and injury level) was similar between general bicycle crashes and bicycle-vehicle crashes, indicating that there were no additional biases present in police-reported bicycle-vehicle crashes (Stutts & Hunter, 1998).

There has been extensive research into the wide-ranging benefits associated with cycling participation, both to the individual and to society. Participation in physical activity results in significant health benefits for the individual. It is associated with a reduced risk of cardiovascular disease, diabetes and cancer. Physical activity is considered an important method in reducing the risk of being obese (Australian Institute of Health and Welfare, 2004). Obesity rates are lower in countries where active transport modes, such as cycling, are preferred (Pucher & Renne, 2003).

In addition to the health benefits there are substantial environmental benefits associated with increased rates of cycling, and the subsequent decrease in vehicle use. It is estimated that half of the greenhouse emissions generated by an average Australian household are transport-related (Cycling Promotion Fund, 2007). Cycling results in negligible CO_2 emissions, while a petrol-fuelled passenger car produces 0.3kg of CO_2 per kilometre travelled. There is also a significant amount of indirect pollution associated with vehicles, from manufacture, delivery and the infrastructure required.

Australian research conducted on behalf of the Commonwealth Department of Health and Ageing calculated the economic benefits of cycling to the community at current participation levels (Bauman et al., 2008). It is estimated that the current value of cycling participation to the health system at $227 million each year. Additional economic benefits also exist. Cycling reduces congestion, with an estimated benefit of $63.9 million per annum (Bauman et al. 2008). By replacing even a small number of vehicles with bicycles reduces roadway demand and creates benefits for all users (Aultman-Hall, 2004). Bauman et al (2008) suggest that increasing the viability of cycling as a transport method would also contribute to increased road safety through reduced car usage, with road trauma in Australia currently costing at least $17 billion per year (Bauman et al, 2008).

Research from the UK found that while cyclists account for 1% of total road users, they represent 5% of all road fatalities and 7% of all serious injuries (Hamilton & Rollin Stott, 2004). Cyclists are 14 times more likely than car drivers to be involved in fatal or serious injury road incidents. It has not been possible to calculate exposure rates for Queensland cyclists. Data regarding distance travelled, or even the number of cyclists in Queensland is not currently available. As such, it is not possible to determine if the risk of injury or death is similar to UK data. In addition, accurate analysis of bicycle collisions is difficult. Worldwide, bicycle crashes are the lowest reported with single-vehicle bicycle crashes rarely reported in official road statistics (less than 10%) (Elvik & Mysen, 1999). Analysis of Western Australian road crash statistics found that at least one other vehicle was involved in 93% of reported bicycle crashes, similar to statistics from USA (Goodno, 2004) and Europe (Stone & Broughton, 2003). When hospital admissions data for Western Australia were examined, only 16% of bicyclists' hospitalisations were a result of a bicycle-vehicle collision (Meuleners et al, 2003). While it is recognised that bicycle injuries are underreported, bicycle-vehicle collisions are more likely than single-vehicle bicycle crashes to be included in road crash statistics, due to incidents usually occurring on roadways and being of a more serious nature (Stutts & Hunter, 1999).

Cyclists are often demonised by the driving public. These negative opinions are also frequently presented in popular media. One article called for cyclists to be decapitated (Parris, 2007). Jeremy Clarkson frequently ridicules and berates cyclists in his column in The Sun (UK), and fellow journalist Mike O'Connor (news.com.au) also expresses negative opinions. The gulf between cyclists' and drivers' opinions is demonstrated in public forums in response to news reports (http://www.abc.net.au/news/stories/2008/05/08/2238772.htm). The belief frequently held is that car drivers are the victim of cyclists, with cyclists putting themselves and other road users at risk (Fincham, 2006a). Research conducted in the United Kingdom further explores driver perceptions of cyclists (Basford et al, 2002). The majority of drivers express negative associations with cyclists. Cyclists are usually perceived as irresponsible, and having no formal training. Many believe that cyclists should not be allowed on roads due to the risks they pose to themselves and others. Often cyclists are viewed as dangerous as they behave in an erratic and arrogant manner. Most drivers believe cyclists are inconvenient. The primary reason identified for drivers' negative perceptions was cyclists failing to adhere to the road rules. Investigation also revealed that approximately one fifth of drivers indicated they found cyclists annoying because they impede drivers (Basford et al, 2002).

Several factors, including risk perception and sensation seeking, are considered to be determinants of road user behaviour (Rothengatter, 1997). Research indicates that a willingness to commit traffic violations is related to accident involvement (Parker et al, 1992). A likelihood of traffic violation commission is associated with high sensation seeking scores on psychological measures (Rimmö & Åberg, 1999). These measures demonstrated a difference between violations and other driver errors (mistakes, inattention and inexperience) (Rimmö & Åberg, 1999). Responses on the sensation seeking scale were shown to be an effective predictor of the number of traffic violations committed, unrelated to age or kilometres travelled (Trimpop & Kirkcaldy, 1997). However it important to remember that it is often difficult to distinguish between a driver error and a traffic violation. Failure to yield may be attributed to either factor, and it is possible that the consequence of one is aggravated by the other (Rothengatter, 1997).

Cyclists are difficult road users to profile. In addition to the usual variations associated with age and gender, there are various sub-groups with different motivations for cycling. They range from recreational cyclists who ride infrequently, to commuters and to athletes. It has been suggested that personality traits play a role in sport participation, as well as differences present in level of ability within sports (Kirkcaldy, 1982). As road cycling is considered an endurance activity, it is believed participants are less likely to be impulsive (Svebak & Kerr, 1989). Sensation seeking is interpreted as individuals underestimating risks associated with situations (Zuckerman, 1983), and is associated with exercise participation choices. Research found that different sub-groups of cyclists (road and mountain bike) demonstrated no differences in sensation seeking (Duroy, 2000). This suggests that competitive cycling sub-groups demonstrate similar psychological traits. No comparisons were made between cyclists and the general population. Assessment of other personality traits for elite cyclists, recreational cyclists (anyone participating in bicycle riding without competition) and non-athletes has been conducted. Elite cyclists had greater narcissistic traits and displayed less negative traits (Gat & McWhirter, 1998).

There has been limited research into the risk-taking behaviours that contribute to bicycle-vehicle collisions. Sociological investigations have been conducted, with current attitudes being that cyclists are law-breakers. The cycling population is broken up into several sub-groups, with the perceived greatest law-breaking sub-group of the bicycling community being bicycle messengers (Fincham, 2006b). However no quantitative research has been conducted into the level of adherence to road rules of cyclists in general traffic situations, with research focusing instead on crash involvement. Analysis of fatal bicycle crashes in the UK established 50% of cycling fatalities had at least one traffic violation involved (McCarthy & Gilbert, 1996). This research did not specify whether it was the vehicle or bicycle involved in the incident that had broken at least one road rule. Research from the US suggests that the vehicle may be more liable in bicycle-vehicle collisions. Research by Hunter et al. (1996), presented in the National Cooperative Highway Research Program Report (2008) demonstrated that the vehicle was at fault in 42.5% of collisions, the cyclist in 35.9%, with the remaining 21.6%

undefined. While the information presented was not detailed in terms of violations committed or other factors involved, it did indicate that the single most frequent crash type was vehicle failing to yield in crossing path crashes at 21.7%.

This study analyses police-reported bicycle-vehicle collisions in Queensland to identify the characteristics of these types of bicycle crashes and the role of road rule violations by cyclists. Detailed analysis of crash reports will facilitate an understanding of the road behaviour of both cyclists and drivers.

Results

<u>General crash characteristics for bicycle-vehicle collisions</u>

In the years 2000-2005 there were 1317 bicycle crashes reported to Queensland Police as occurring on roads within the Brisbane City Council area (Queensland Transport, 2007). This does not include crashes occurring on private property, or off-road areas not considered part of the road reserve (for more information refer to the Australian Road Rules). Of the reported crashes, 1214 were bicycle-vehicle crashes (92.2%).

Demographics
Cyclists aged 25-49 were most likely to be involved in crashes as illustrated in Figure 1. A quarter of all bicycle-vehicle collisions involved cyclists aged 30-39. The majority of incidents involved male cyclists (82.5%).

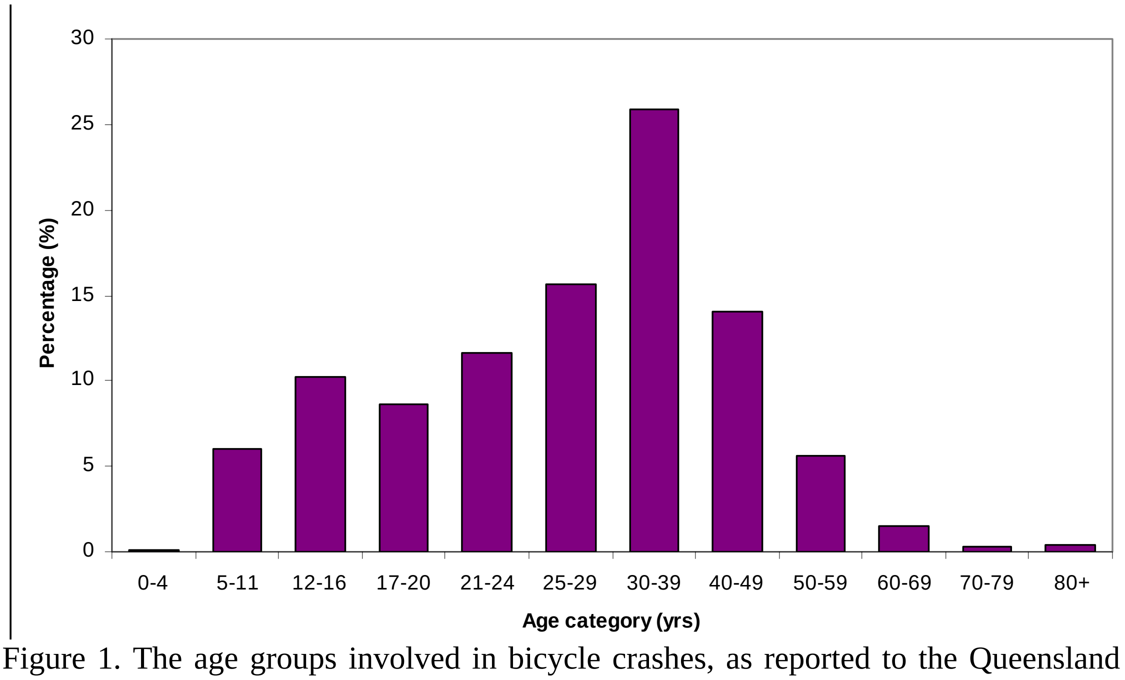

Figure 1. The age groups involved in bicycle crashes, as reported to the Queensland Police Service.

Environmental Conditions
The majority of crashes occur during peak traffic periods (Figure 2). When vehicles are involved, the highest number of crashes are reported in the afternoon peak (31.1%), closely followed by the morning peak (30.1%). As such, most bicycle-vehicle collisions occur in daylight conditions (80.4%). Of the 18.6% of crashes that occur in dark conditions, the

majority (82.4%) occur in lighted darkness. Bicycle-vehicle collisions were more likely to occur in clear conditions (96.4%).

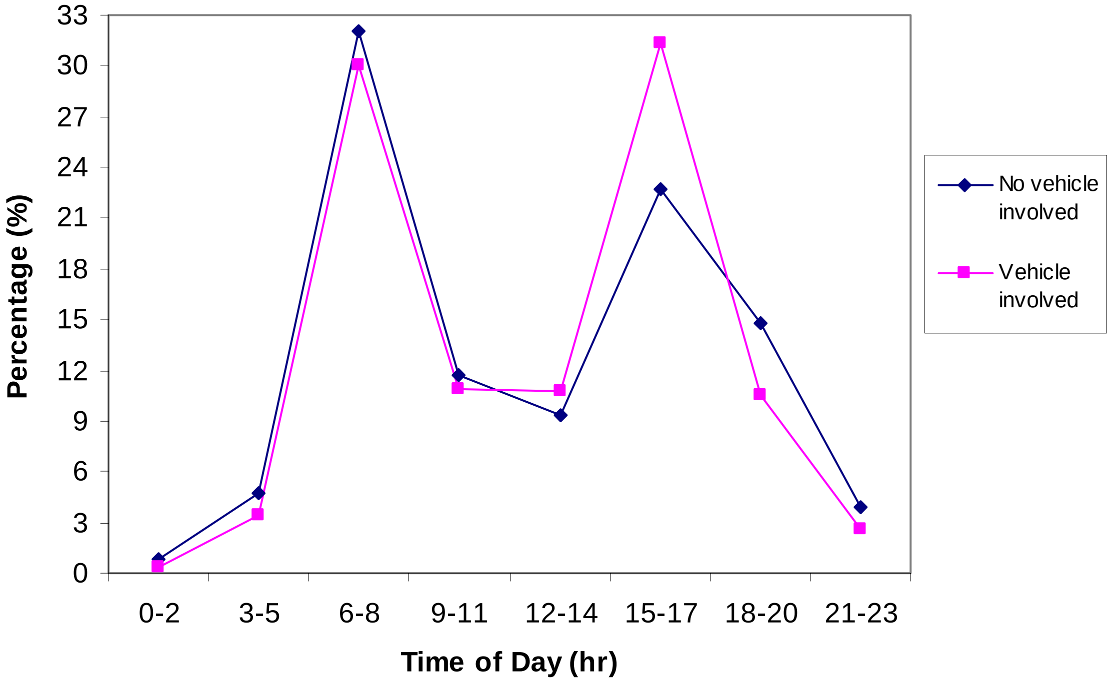

Figure 2. A comparison of the time of bicycle crashes according to vehicle involvement.

Road Environment

Bicycle-vehicle collisions are most likely to occur at intersections. Of the reported crashes, 15.5% occurred at cross intersections, 36.6% at T junction, 5.3% at a roundabout, 1.7% at an interchange, 0.4% at a junction of multiple roads, 0.2% at a Y junction, and merging traffic lanes recorded 0.1% of reported crashes. Few crashes were reported at other roadway features. Many collisions were reported in locations absent of roadway features (39.4%). Compared with bicycle-vehicle collisions, vehicle crashes are more frequent at cross, interchanges, and the absence of any road feature (Figure 3.).

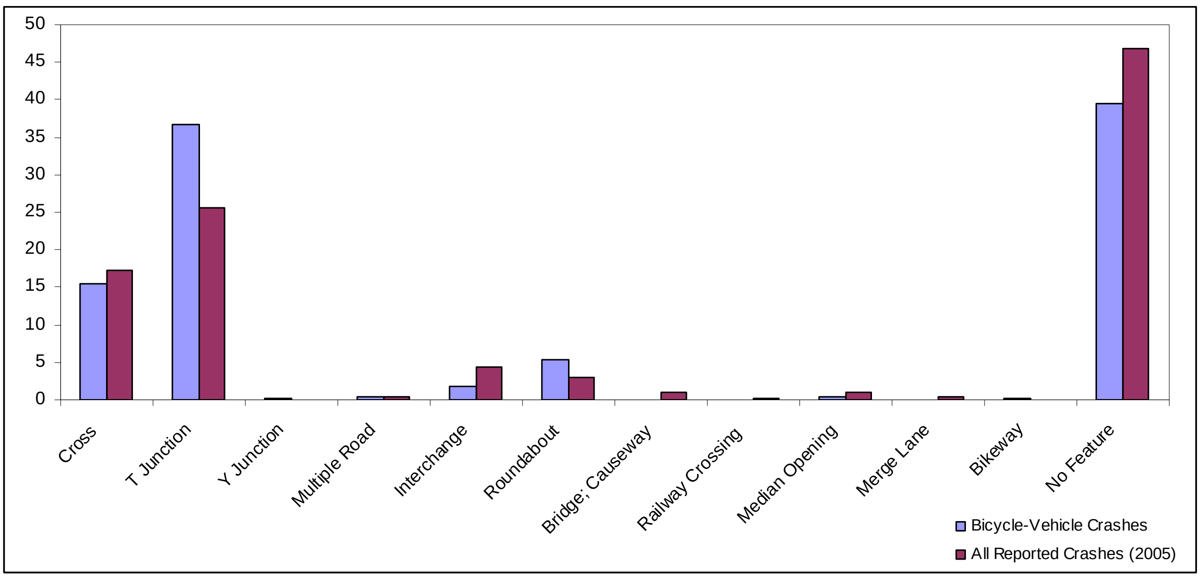

Figure 3. A comparison of crash locations

Most crashes occurred on roads with unobscured view, with 87.5% occurring on straight roads and only 2.5% occurring on curves with obscured view. The majority of bicycle-vehicle collisions occurred on level roads (67.5%), with 26% on a grade, 2.5% on a road crest and 4% in a dip.

The majority of crashes occur at locations with no traffic control (66.6%). Intersection controls were the next most reported (13.8% at give way signs, 13.3% at operating traffic lights, and 5.2% at stop signs), with minimal crashes occurring at other types of control: railway crossings (0.1%), pedestrian crossings (0.7%), pedestrian operated lights (0.3%) and traffic controller (0.1%).

Roads of varying capacities, utilising the hierarchy developed by Eppel, Olsen & Partners which has been adopted by Queensland planning agencies (Eppel, McClurg & Bunker, 2001), reported different levels of bicycle-vehicle crashes. Most bicycle crashes occurred on collector streets (53.2%) and local streets (40.1%). Sub-arterial roads(6.3%) and Arterial (0.3%) had few crashes involving bicycles. Bicycle-vehicle crashes were most likely to have occurred at suburban speed limits, with 91.8% crashes occurring on roadways with a speed limit of 50 or 60kph. Of the other speed zones: 3% occurred in 70kph speed zones, 2.2% occurred in zones of 80-100, 2.2% occurred on 40kph roads, with 0.7% occurring on roadways with speed limits of 30kph or less. Of the police-reported bicycle crashes that occurred on carriageways, 87.6% occurred where no bicycle lane was provided.

Crash Severity

For cyclists involved in bicycle-vehicle collisions, the following outcomes were noted. Fatalities were a recorded in 0.7% of crashes, hospitalisation in 31.9% cases, medical treatment was required for 43.8% of crashes and 23.6% of bicycle-vehicle crashes resulted in minor injury. No property damage only crashes were recorded.

Of the 1214 reported bicycle-vehicle crashes, which all recorded injury to the cyclist, only 13 crashes resulted in injury to vehicle occupants. There were 5 crashes where the vehicle driver was treated for injuries, with three requiring medical attention and two reporting minor injuries. Eight bicycle-motorcycle collisions resulted in motorcyclist injury. For motorcycle riders, one fatality, one hospitalisation, one crash requiring medical treatment and 3 resulting minor injuries were reported. In separate collisions, two pillion passengers were injured. Of these, one required medical treatment and one resulted in minor injuries.

<u>Further analysis of crashes</u>

An angle crash (two vehicles approaching from angular directions that collide, typically a result of one vehicle failing to stop or yield) was the most commonly identified type occurring between bicycles and vehicles at 68.5%. This was followed by sideswipes (14.9%) and hitting a parked vehicle (6%). Rear end (4.7%) and head on (1.3%) collisions were the only other crash types to reach greater than 1%.

The police identified the bicycle as the at-fault party in 35.9% of reported crashes for the years 2000-2005, while vehicles were at fault in 63.6%. In bicycle-vehicle collisions, the cyclist was the at-fault party in 369 instances (30.6%). In the remaining crashes (single vehicle, or crashes involving pedestrians, wheeled recreational vehicles or railway stock, multiple bicycle incidents) cyclists were at-fault in 93% of crashes.

The distribution of fault in bicycle-vehicle collision changes with bicycle operator age (Figure 4). Cyclists younger than the legal driving age were at fault in 66.3% of collisions involving vehicles, compared with cyclists aged 17 years or older who were at fault in 23.3% of incidents. The age group with the lowest nominated at-fault rate were those aged 50-59, at fault in only 13.4% of collisions.

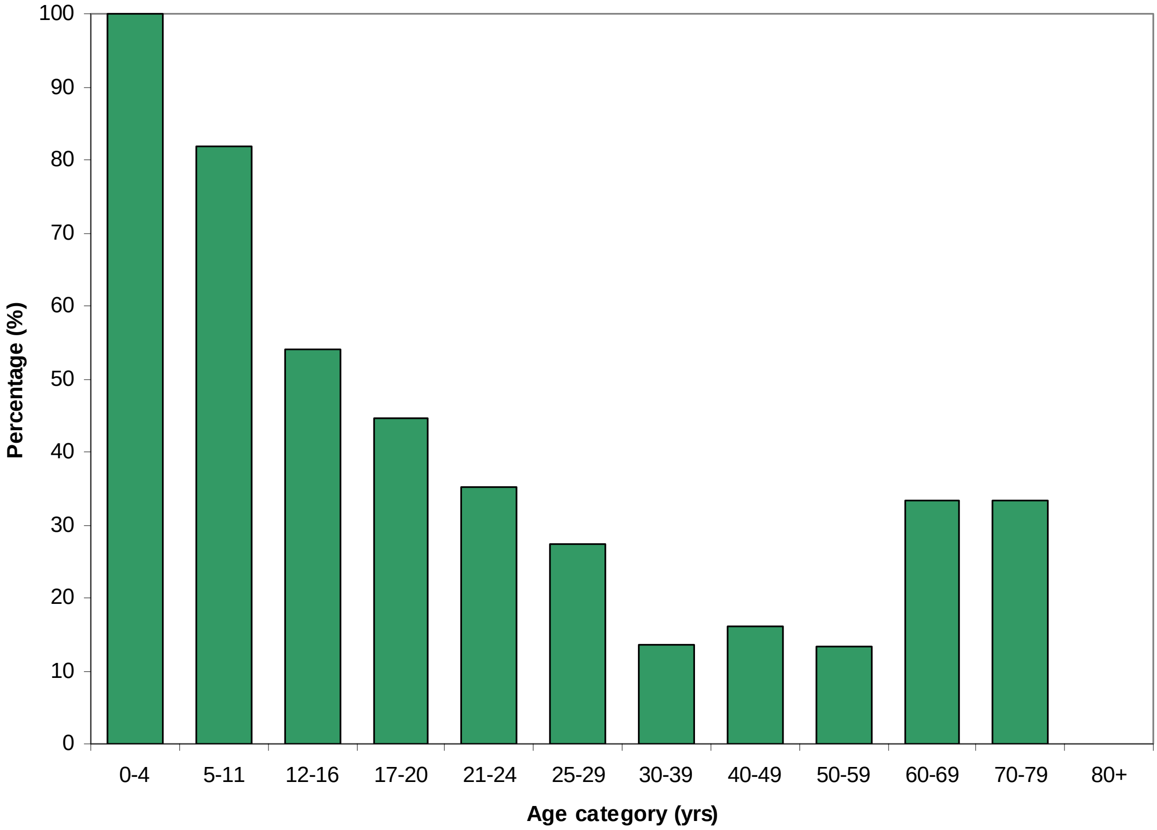

Figure 4. The percentage of bicyclists in each age category considered at-fault in bicycle-vehicle collisions reported to police.

<u>Contributing factors in bicycle-vehicle collisions</u>

Traffic violations were indicated as occurring in, and contributing to 67.7% of all reported bicycle-vehicle collisions. And while traffic violations were not always the initial factor indicated (due to the nature of QPS reporting systems), multiple factors were recorded in 73.6% of crashes. The three factors common to motor vehicle crashes, speed, alcohol and fatigue, are not frequently observed in bicycle crashes. A blood alcohol concentration violation was identified in 0.6% of bicycle crashes, excessive speed for circumstances in 1.6%, exceeding the speed limit in 0.2% of crashes, and fatigue was identified as a factor in 0.2% of crashes. Traffic violations (undue care and attention 16.3%, fail to give way 9.6%, turn in the face of oncoming traffic 10.5%, disobey give way sign 9.2% and opening a car door causing danger 4.1%) and driver conditions (inattention or negligence 14.1%, and inexperience or lack of expertise 11.1%) were more likely to be contributing factors. Traffic violations were recorded in only 27.8% of crashes where cyclists were deemed at fault, compared to 86% of crashes where the vehicle driver was at fault ($r= -.422$, $p=0.01$).

In reported collisions where the vehicle was considered the “at-fault” party the most frequently reported contributing factors were: undue care and attention (19.5% of crashes), turning in the face of oncoming traffic (15.9%), failure to give way (15.3%), disobey a give way sign (13.0%), miscellaneous factors (10.0%), vehicle entering a driveway (7.3%), inattention or negligence (6.7%), opening a car dor causing danger (6.5%), improper turn other than u-turn (4.1%), disobey stop sign (3.9%) and miscellaneous road conditions (3.5%).

When the bicycle was the at fault party, the contributing factor most reported was rider inattention or negligence (35.3%). Of the 10 most frequently occurring factors in crashes, four were traffic violations: disobey a give way sign (3.0%), fail to give way (4.0%), disobey traffic light (6.5%) and undue care and attention (7.5%). The remaining factors reported were driver inexperience/lack of experience (18.6%), miscellaneous factors (6.2%), having headlights off or no lights on vehicle (5.9%), miscellaneous road conditions (3.0%), vehicle brakes (3.%) and excessive speed for circumstances (2.7%).

The most frequent factor in bicycle-vehicle crashes, regardless of attribution of blame, is operator attention. The distinction relating to driver attention, particularly whether it is reported as a violation (undue care and attention) or as negligent driving (inattention or negligence) is a discretionary matter. Further information regarding the reasons for predominantly classifying inattention by cyclists as negligent driving as opposed to a violation is not available. Further research is needed to understand if this is the effect of a reporting bias, or an actual difference in crash circumstance.

Discussion

This study demonstrates that the cycling population includes people of all age groups. The results indicate that 16.1% of the cycling population involved in bicycle-vehicle crashes are aged 16 or younger, with 6.1% aged 11 or younger. Most cyclists involved in bicycle-vehicle collisions were old enough to hold a drivers licence. While no data was available on licence status for the riders involved in reported collisions, it is estimated that approximately 84.5% of Queensland residents who own a bicycle hold a licence (ABS, 2004). This indicates that the majority of cyclists should be aware of the road rules. When a cyclist aged 16 years or younger was involved in a bicycle-vehicle collision, they were most likely to be the at fault party, with trend decreasing as age increased. Cyclists aged between 30 and 59 were least likely to be at fault in bicycle-vehicle crashes, with attributed blame increasing again as age increased (this trend should be treated with caution, as only 24 crashes involved cyclists aged 60 years or greater, with only 8 involving a rider aged 70 years or older). These results suggest that lack of knowledge of road rules (those younger than legal driving age), age-related cognitive abilities (Cross & Hall, 2005) and traffic risk-taking behaviours (highlighted by research into young drivers) may be associated with bicycle-vehicle collisions, and should be considered when developing interventions.

The majority of bicycle-vehicle crashes are not a result of environmental factors. The bulk of collisions occurred in good lighting and atmospheric conditions. Many reported crashes occurred on roads without an obstructed view, in the absence of a reported road feature, on suburban and urban roads. Intersections, did however register the greatest number of crashes, with the highest being T junctions.

Most (68.5%) reported crashes are angle crashes, with vehicles at fault in 70% of angle crashes. This would suggest that it is drivers are turning in front of or turning into cyclists causing these crashes. This result may highlight the difficulties drivers have in assessing bicycle speed and/or positioning, a general lack of awareness of cyclists on roadways by drivers, or that conspicuity of cyclists in the road environment is an issue.

The analysis would suggest that it is usually driver behaviour that contributes to bicycle-vehicle collisions, with the motor vehicle being the at fault unit in nearly two thirds of reported crashes. This trend is even more noticeable in bicycle-vehicle collisions where the cyclist is of driving age. Traffic violations were reported in over two thirds of bicycle-vehicle collisions. In crashes where traffic violations were found to have occurred, vehicles were more likely to have broken the road rules. This is in contrast to the popularly held opinion that cyclists' failure to adhere to road rules results in crashes, and supports European and US findings (Hunter et al, 1996). It is not possible to make conclusions about general road behaviour of cyclists or drivers from the results of this study.

This study is limited by the fact that approximately only 10% of bicycle crashes are reported and included in road crash statistics (Veisten et al., 2007). While bicycle-vehicle collisions that result in a fatality or serious injury are likely to be reported in crash statistics, it is more difficult to determine the representativeness of the bicycle-vehicle collisions resulting in less serious injury.

The reported statistics are also limited in that only crashes occurring on public road-related areas are included. Queensland Transport defines the road reserve as including: the carriageway; foot/cycle paths inside the road reserve, median strips, traffic islands, driveway access inside the road reserve and railway level crossings (Data Analysis Unit, 2008). Crashes occurring on foot/cycle paths outside the road reserve (segregated paths not near the road, often through parkland), recreational areas, off-road parking areas, roads temporarily closed to the public and private property are not included (Data Analysis Unit, 2008). Crash records are also subject to reporting errors and other issues relating to police data including: items requiring subjective judgement, actual speed of vehicles in the crash, differential underreporting of different crash types, and that vehicle movements leading to a crash are often difficult to describe (Hutchison et al, 2006).

Approximately 37% of the Queensland population rides a bicycle (ABS, 2004). As a proportion of traffic modes, it is estimated only 3% of commuting is completed by bicycle (Queensland Transport, 2006). However, this statistic is limited as only traffic commuting to the CBD and CBD fringe was included. Due to the lack of formal requirements to ride a bicycle, no licensing or registration processes, and limitations of technology there are no accurate measures of cycling numbers on the roadway network. This makes it difficult to develop exposure measures.

The diversity in the cycling population is again highlighted when interventions are assessed. Possible interventions include: bicycle paths, which – while designed for high speeds – are often not utilised by distance commuters due to the fact that it is not possible travel constantly at high speed (Austroads, 1999); shared paths or ability to use the footpath, which is appropriate for recreational cyclists travelling <12kph, although not appropriate for cyclists travelling >15kph (Hutchison et al, 2006); and improved road facilities through improving visibility at intersections, signal timing, signage, bitumen marking, intersection geometry, accommodating cyclists on roundabouts, or providing facilities or shoulders, and fixing or removing surface irregularities (NCHRP, 2008). While many engineering and design interventions have been tried, their effectiveness has not been established (NCHRP, 2008). The establishment of policies proposed to increase the safety of cyclists as vulnerable road users is often hindered by the divergent policies expressed by different departments responsible for cycling in a single government. Two separate statements by sections of the Queensland Government from the Queensland Cycling Strategy and the Queensland Road Safety Strategy demonstrate opposing views on the treatment of cyclists as road users (Haworth, 2006). The majority of road safety interventions implemented through the Road Safety Strategy are designed to be of maximum benefit to vehicle occupants, with little benefits to cyclists and vulnerable road users in general.

Interventions can be enhanced with appropriate public information and education programs. Share the road programs have been implemented in Queensland and Canada. These programs highlighted motorists and cyclists responsibilities while using the road. It is also suggested that bicycle education programs should be implemented to increase cyclists' skills and knowledge.

While safety interventions are designed to retrospectively improve cyclist safety, road design is an important factor. Policy bodies in Australian and the United States suggest there is no substitute for adequately designing and constructing roads for bicycle travel (Austroads, 1999; NCHRP, 2008).

References

Aultman-Hall, L. (2004). A bicycle transportation primer: dispelling the myths and promoting the realities, *ITE Journal on the web*, http://www.ecohusky.uconn.edu/documents/ ABicycleTransportationPrimer.pdf

Australian Bureau of Statistics. (2004). *Bicycle Usage: Queensland*. Document 9215.3. Australian Bureau of Statistics, Canberra.

Australian Institute of Health and Welfare, (2004). *Physical Inactivity*. url: http://www.aihw.gov.au/riskfactors/inactivity.cfm

Austroads (1999). *Guide to Traffic Engineering Practice. Part 14 – Bicycles*. Austroads, Sydney.

Basford, L., Reid, S., Lester, T., Thomson, J. & Tolmie, A. (2002). *Drivers' perceptions of cyclists*. (No TRL549). Transport Research Laboratory, Berkshire.

Bauman, A., Rissel, C., Garrard, J., Ker, I., Speidel, R. & Fishman, E, (2008). *Cycling: Getting Australia Moving: Barriers, facilitators and interventions to get more Australians physically active through cycling*. Cycling Promotion Fund, Melbourne.

Berry, J.G. & Harrison, J.E. (2008). *Serious injury due to land transport accidents, Australia, 2005-2006*. AIHW Injury Research And Statistics Series #42. Australian Institute of Health and Welfare, Canberra.

Cross, D.S. & Hall, M.R. (2005). Child pedestrian safety: the role of behavioural science. *Medical Journal of Australia*, 182 (7): 318-319.

Cycling Promotion Fund, (2007). *Environmental benefits of cycling*. Cycling Fact Sheet 02. url: http://www.cyclingpromotion.com.au/images/stories/factsheets/02_TheEnvironmentalBenefitsOfCycling.pdf

Data Analysis Unit (2008). *Data Analysis Unit Road Crash Glossary, June 2008*. Queensland Transport, Brisbane.

Duroy, L.C. (2000). *A comparison of sensation seeking and personality measures between road cyclists and mountain bikers.* Graduate College. Stillwater, Oklahoma, Oklahoma State University. Doctor of Philosophy: 24-35.

Elvik, R. & Mysen, A.B. (1999). Incomplete accident reporting: Meta-analysis of studies made in 13 countries, *Transportation Research Record 1665*, 133-140.

Eppel, V.A.T., McClurg, B.A. & Bunker, J.M. (2001). A four level road hierarchy for network planning and management. In Jaeger, V. (ed.). *Proceedings 20th ARRB Conference*, Melbourne.

Fincham, B. (2006a). Bicycle messengers and the road to freedom. *The Sociological Review*, 54 (s1): 208-222.

Fincham, B. (2006b). Back to the ‘old school’: bicycle messengers, employment and ethnography. *Qualitative Research*, 6 (2): 187-205.

Gat, I. & McWhirter, B.T. (1998). Personality characteristics of competitive and recreational cyclists. *Journal of Sport Behaviour*, 21 (4): 408-420.

Goodno, M (2004). *Bicycle Collisions in the District of Columbia: 2002-2004*. District Department of Transportation, District of Columbia, p.7.

Hamilton, R.J. & Rollin Stott, J.R. (2004). Cycling: the risks, *Trauma*, 6 (2): 161-168.

Haworth, N. (2006). Integrating policy approaches for vulnerable road users. In *Proceedings 29th Australian Transport Research Forum*, Gold Coast, Australia

Hunter, W.W, Stutts, J.C., Pein, W.E. & Cox, C.L. (1996). *Pedestrian and Bicycle Crash Types of the Early 1990’s*. In: National Cooperative Highway Research Program (2008). *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan. Volume 18: A Guide for Reducing Collisions involving Bicycles*. Report #500. Transportation Research Board, Washington D.C.

Hutchison, T.P., Kloenden, C.N. & Long, A.D. (2006). *Patterns of bicycle crashes in South Australia*. CASR Report Series, CASR028. Centre for Automotive Safety Research, University of Adelaide.

Kirkcaldy, B.D. (1982). Personality profiles at various levels of athletic participation. *Personality and Individual Differences*, 3: 321-326.

McCarthy, M. & Gilbert, K. (1996). Cyclist road deaths in London 1985-1992: Drivers, vehicles, manoeuvres and injuries, *Accident Analysis and Prevention*, 28 (2): 275-279.

Meuleners, L.B., Gavin, A.L., Cercarelli, L.R. & Hendri, D. (2003). *Bicycle Crashes and Injuries in Western Australia*, *1987-2000*. Injury Research Centre, School of Population Health, University of Western Australia, Perth, Australia.

National Cooperative Highway Research Program (NCHRP) (2008). *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan. Volume 18: A Guide for Reducing Collisions Involving Bicycles.* Report #500. Transportation Research Board, Washington D.C.

Parker, D., Manstead, A.S.R., Stradling, S.G. & Reason, J.T., (1992). Determinants of intention to commit driving violations. *Accident Analysis & Prevention*, 24, 117-131.

Parris, M. (2007). What's smug, messy and deserves to be decapitated? Times, The (United Kingdom), 27/12/2007, p. 19.

Pucher, J. & Renne, J.L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, 57 (3): 49-77.

Queensland Transport (2006). *Bicycle mode share to CBD and CBD Fringe 1986 to 2006.* Transport Research & Analysis Centre, Brisbane.

Queensland Transport (2007). *WebCrash: Queensland Crash Database*, Queensland Government, Brisbane.

Räsänen, M., Koivisto, I. & Summala, H. (1999). Car Driver and Bicyclist Behaviour at Bicycle Crossings Under Different Priority Regulations. *Journal of Safety Research*, 30 (1): 67-77.

Rimmö, P-A., Åberg, L., (1999). On the distinction between violations and errors: sensation seeking associations. *Transportation Research Part F2*, 151-166.

Rothengatter, T., (1997). Psychological aspects of road user behaviour. *Applied Psychology: An International Review*, 46 (3), 223-234.

Stone, M. & Broughton, J., (2003). Getting off your bike: cycling accidents in Great Britain in 1990-1999, *Accident Analysis and Prevention*, 35 (4): 549-556.

Stutts, J.C. & Hunter, W.W., (1998). Police Reporting of Pedestrians and Bicyclists Treated in Hospital Emergency Rooms. *Transportation Research Record 1635*, 88-92.

Stutts, J.C. & Hunter, W.W., (1999). Motor vehicle and roadway factors in pedestrian bicyclist injuries: an examination based on emergency department data, *Accident Analysis and Prevention*, 31 (5): 505-514.

Svebak, S. & Kerr, J. (1989). The role of impulsivity in preference for sports. *Personality and Individual Differences*, 10: 51-58.

Trimpop, R. & Kirkcaldy, B., (1997). Personality predictors of driving accidents. *Personality and Individual Differences*, 23 (1), 147-152.

Veisten, K., Sælensminde, K., Alær, K., Bjørnskau, T., Elvik, R., Schistad, T. & Ytterstad, B. (2007). Total costs of bicycle injuries in Norway: Correcting injury figures and indicating data needs, *Accident Analysis & Prevention*, 39 (6), p. 1162-1169.

Zuckerman, M. (1983). Sensation seeking and sports. *Personality and Individual Differences*, 4: 285-293.